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CHAPTER 2

THE CRYPTO ECOSYSTEM AND FINANCIAL STABILITY CHALLENGES

Chapter 2 at a Glance

- The crypto ecosystem continues its rapid growth, presenting both opportunities and challenges. This chapter discusses the latest developments and financial stability challenges posed by the crypto ecosystem, with a focus on emerging market and developing economies.
- Crypto assets come in different flavors and have evolved to meet varying needs for speculative investment, store of value, currency conversion, and payments. Decentralized finance (DeFi) is gaining momentum by offering new services to users.
- Financial stability risks are not yet systemic, but risks should be closely monitored given the global implications and the inadequate operational and regulatory frameworks in most jurisdictions.
- Challenges posed by the crypto ecosystem include operational and financial integrity risks from crypto asset providers, investor protection risks for crypto assets and DeFi, and inadequate reserves and disclosure for some stablecoins.
- In emerging markets, the advent of crypto assets has benefits but can accelerate *cryptoization* and circumvent exchange and capital control restrictions. Increased trading of crypto assets in these economies could lead to destabilizing capital flows.
- Policymakers should implement global standards for crypto assets and enhance their ability to monitor the crypto ecosystem by addressing data gaps. As the role of stablecoins grows, regulations should correspond to the risks they pose and the economic functions they perform. Emerging markets faced with *cryptoization* risks should strengthen macroeconomic policies and consider the benefits of issuing central bank digital currencies.

Introduction

The rapid growth of the crypto ecosystem presents new opportunities. Technological innovation is ushering in a new era that makes payments and other financial services cheaper, faster, more accessible, and allows them to flow across borders swiftly. Crypto asset technologies have potential as a tool for faster and cheaper cross-border payments. Bank deposits can be transformed to stablecoins that allow instant access to a vast array of financial products from digital platforms and allow instant currency conversion. Decentralized finance could become a platform for more innovative, inclusive, and transparent financial services.

Despite potential gains, the rapid growth and increasing adoption[1] of crypto assets also pose financial stability challenges. This chapter discusses the implications of the expansion of the crypto ecosystem and provides an assessment of their associated financial stability risks. For emerging market and developing economies, greater use of crypto assets presents some benefits, but also macro-financial risks, especially with respect to asset and currency substitution—referred to in this chapter as *cryptoization*. The chapter concludes with a set of eight actionable policy recommendations. For readers less familiar with the terminology and developments, Online Annex 2.1 provides a brief description of the taxonomy of crypto assets as well as a brief primer on the crypto ecosystem.[2] The IMF has discussed many critical issues relating to regulatory frameworks with respect to crypto assets and digital money. Some topics that are not covered in detail in this chapter can be found in IMF (2020a) and IMF (2021) along with analysis of financial integrity issues,

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[1]"Adoption" refers to the degree of use of crypto assets by users for transferring and storing value.

[2]A stablecoin is a type of crypto asset that aims to maintain a stable value relative to a specified asset or a pool of assets. Online Annex 2.1 offers more information on definitions. All online annexes are available at www.imf.org/en/Publications/GFSR.

such as anti–money laundering and combating the financing of terrorism (AML/CFT) (IMF 2020a; IMF 2020b); central bank digital currencies (CBDCs); and more (He and others 2016; Mancini-Griffoli and others 2018; IMF 2019).

The market capitalization of crypto assets has grown significantly amid large bouts of price volatility. Through early May, the market capitalization almost tripled in 2021 to an all-time high of $2.5 trillion (Figure 2.1, panel 1). This was followed by a 40 percent fall in May as concerns from institutional holders about the environmental impact of crypto assets grew and global regulatory scrutiny of the crypto ecosystem escalated. The sharp declines during May were likely exacerbated by high use of leverage (Figure 2.1, panel 2), which led to automatic liquidations[3] of margin and futures positions by exchanges. Since then, the market value of crypto assets has increased again to more than $2 trillion—a 170 percent increase year to date at the time of writing.

Despite significant price appreciation, the returns of non-stablecoin crypto assets are less impressive when adjusted for volatility. For example, the risk-adjusted returns of Bitcoin over the past year are similar to the performance of broader technology equities or the S&P 500 (Figure 2.1, panel 3). However, investors are exposed to larger drawdowns. The relative attractiveness of these crypto asset returns can be higher when compared with other asset classes that also experience large drawdowns, such as local currency bonds and equities in some emerging market and developing economies with weak fundamentals. Another argument often put forward in favor of non-stablecoin crypto assets is their low correlation with other assets, offering diversification benefits to investor portfolios (see the April 2018 *Global Financial Stability Report*). Although this is true to some extent, the correlation between these crypto assets and some key asset classes increased significantly during recent episodes of market stress (for example the COVID-19 sell-off in 2020). The diversification benefit could also decline over time if there is continued involvement of institutional holders that are affected by common factors.

A key component of the rise in market capitalization is increasing investor interest in stablecoins; newer technologies, such as Ethereum; other "smart contract" blockchains; and decentralized finance.

- *Stablecoins:* Their market capitalization has quadrupled in 2021 to more than $120 billion (Figure 2.1, panel 4). Tether is the largest stablecoin, but its market share has declined sharply as major centralized crypto exchanges have introduced their own versions (for example, USD Coin by Coinbase and Binance USD by Binance). Stablecoin trading volumes outpace those of all other crypto assets (Figure 2.1, panel 5) primarily because they are highly usable for settlement of spot and derivatives trades on exchanges. The price stability for the top stablecoins continues to improve, as can be seen in the declining price deviations from the targeted 1:1 peg with the dollar and other currencies in 2021.[4] Their relative price stability has shielded users from the volatility of other crypto assets, which means they do not have to move their funds outside the crypto ecosystem.
- *Ethereum and other "smart contract" blockchains:* Bitcoin remains the dominant crypto asset, but its market share has declined sharply in 2021 from more than 70 percent to less than 45 percent. Market interest has grown for newer blockchains that use smart contracts and aim to solve the challenges of earlier blockchains by introducing features to ensure scalability, interoperability, and sustainability.[5] The most prominent is Ether, which surpassed Bitcoin trading volumes earlier in 2021 (Figure 2.1, panel 5).
- *Decentralized finance (DeFi):* The size[6] of DeFi grew from $15 billion at the end of 2020 to about $110 billion as of September 2021 (Figure 2.1, panel 6) largely due to the rapid growth of (1) decentralized exchanges that allow users to

[3]Liquidations happen when investors do not meet margin requirements and exchanges automatically close the positions.

[4]The pricing dynamics of stablecoins have been examined in several studies (see discussion in Lyons and Viswanath-Natraj 2020) that generally identify stablecoins as safe havens during periods of crypto asset turbulence.

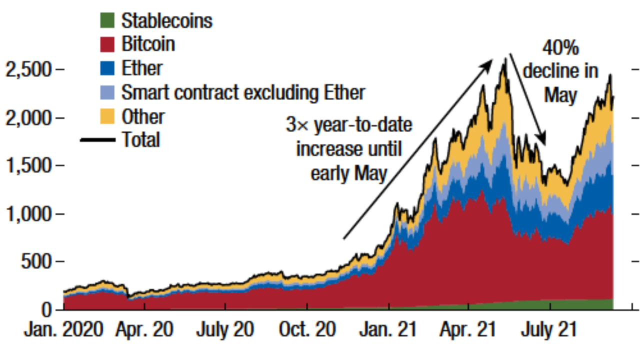
[5]*Scalability* refers to the ability to handle large transaction volumes. *Interoperability* is the ability to connect with other blockchains as well as off-chain data. *Sustainability* is the ability to scale in an environmentally sustainable way while retaining a robust governance structure.

[6]Size refers to the total value locked, or the total dollar value of all collateral deposited in DeFi platforms. The term "locked" is misleading, given that this collateral can be removed quickly by users. Moreover, collateral can be reused between platforms, inflating the overall total value locked.

Figure 2.1. Crypto Ecosystem Market Developments

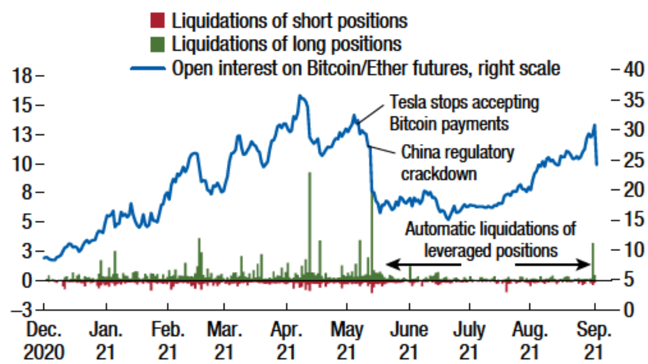
The market value of the ecosystem increased dramatically in 2021 and expanded beyond Bitcoin.

1. Market Capitalization for Crypto Assets
(Billions of US dollars)



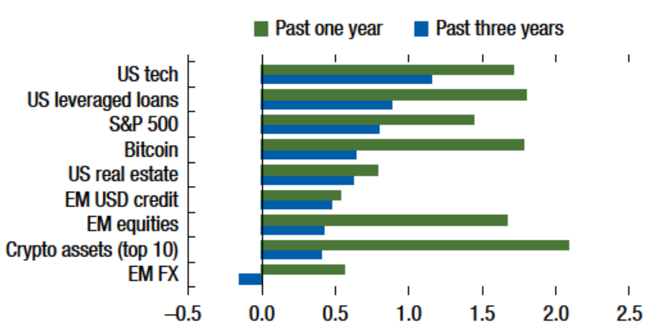
The April/May 2021 sell-off was accompanied by a sharp unwinding of leveraged positions from all-time highs.

2. Liquidations of Futures and Open Interest
(Billions of US dollars)



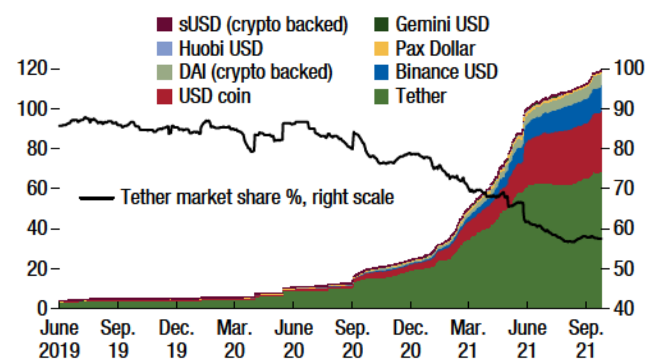
Risk-adjusted returns of non-stablecoin crypto assets are comparable to other mainstream benchmarks.

3. Risk-Adjusted Returns
(Sharpe ratio)



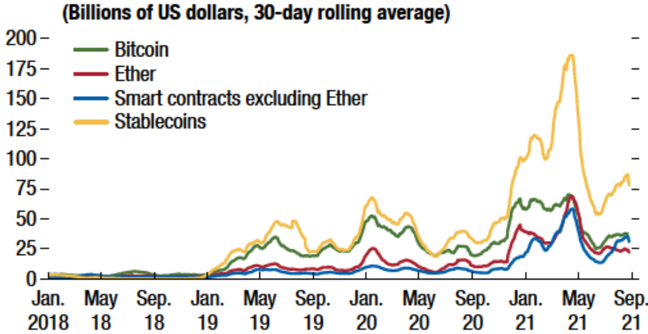
The market cap of stablecoins has quadrupled in 2021 while Tether's dominance has declined.

4. Stablecoin Market Capitalization
(Billions of US dollars and percent share)



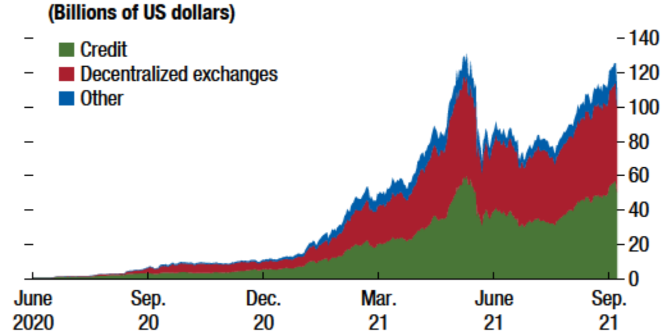
Trading volumes of stablecoins, Ether, and other smart contracts rose rapidly in 2021.

5. Daily Trading Volumes on Exchanges
(Billions of US dollars, 30-day rolling average)



The collateral "locked" in decentralized finance has risen sharply, led by decentralized exchanges and credit platforms.

6. Total Value Locked in Decentralized Finance
(Billions of US dollars)



Sources: Bloomberg Finance L.P.; Bybt; CoinGecko; CryptoCompare; DeBank; and IMF staff calculations.
Note: Liquidation data are provided by Bybt. Post–April 27 liquidations are likely to be underestimated, given changes in Binance's application programming interface that stopped real-time data feeds. In panel 3, Sharpe ratios are calculated on a rolling 12-month basis and annualized. EM = emerging market; FX = foreign exchange; USD = US dollar.

trade crypto assets without an intermediary and (2) credit platforms that match borrowers and lenders without the need for a credit risk evaluation of the customer (Figure 2.1, panel 6). These services operate directly on blockchains (usually) without customer identification requirements. Most of DeFi is built on the Ethereum blockchain and uses Ethereum-based tokens, including stablecoins. DeFi is also one of the main drivers of the rapid growth of stablecoins and warrants close attention. Chainalysis (2021b) highlights that DeFi users for now are primarily institutional players from advanced economies, whereas adoption among retail users and emerging market and developing economies in general is lagging.

What Are the Financial Stability Implications of Crypto Assets?

In October 2018 the Financial Stability Board concluded that crypto assets did not pose a material risk to global financial stability (FSB 2018) but identified several transmission channels that could change its assessment. These channels include risks from the size of market capitalization, investor confidence effects, risks arising from direct and indirect exposures of financial institutions, and risks from the use of crypto assets for payments and settlements.

Since then, some of these channels have grown notably, and new sources of risk have emerged.

- *Market capitalization* has grown by a factor of 10 and is now comparable to some established asset classes (for example US high-yield bonds). It is still small, however, compared with government bond and stock markets in major advanced economies.
- Episodes of *loss of confidence in crypto assets* so far have had limited spillovers to broader markets despite large fluctuations in crypto asset valuations. Confidence effects from failures of crypto asset providers have also been limited so far. However, their importance is rising as trading volumes in some countries' exchanges have increased dramatically and, in some cases, are comparable to the volumes of their respective domestic stock exchanges.
- *Exposures to crypto assets* in the banking system are growing, albeit from a low base. Exposures appear to be growing faster among some nonbank institutions, most notably hedge funds,[7] which can lead to increased indirect exposures of the banking system.
- The *use of crypto assets for payments and settlements* is still limited, with some exceptions (see the "Cryptoization" section). This channel can accelerate rapidly, given that several global payment companies have only recently started to integrate with the crypto ecosystem, in particular with stablecoins.

Finally, *new sources of risk* are emerging, such as stablecoins and DeFi, which did not exist on a large scale in 2018. In the future, a widely used stablecoin or DeFi service with a reach and use across multiple jurisdictions could scale up quickly and become systemically important.

Innovations that have given rise to the crypto ecosystem are significant and can create tangible benefits for countries, but the risks should be kept in check. At a global level, financial stability risks appear contained for now,[8] but the macro-criticality of crypto assets, and in particular stablecoins, can be significantly higher for some emerging market and developing economies where adoption has progressed fast. The next sections focus on the following issues (Table 2.1): (1) challenges from the crypto ecosystem arising from operational risks, market integrity, data availability, and cross-border activities; (2) stablecoin-specific issues linked to their design, use, and regulation and supervision at the domestic and global levels; and (3) macro-financial stability issues such as cryptoization, which are more prominent in emerging market and developing economies.

Challenges Posed by the Crypto Ecosystem

The rapid growth of the ecosystem has been accompanied by the entrance of new entities, some of which

[7] These are some examples: Coinbase reported that 10 percent of the 100 largest hedge funds were using their platform as of 2021:Q2; a Goldman Sachs (2021) survey shows that 15 percent of family offices have exposures to crypto assets, and close to half are potentially interested in initiating exposures.

[8] The April 2018 *Global Financial Stability Report* reached a similar conclusion about the macro-criticality of crypto assets at that time.

Table 2.1. Financial Stability Challenges

Crypto Ecosystem	• Operational, cyber, and governance risks • Integrity (market and AML/CFT) • Data availability/reliability • Challenges from cross-border activities
Stablecoins	• How stable are stablecoins? • Domestic and global regulatory and supervisory approaches
Macro-Financial	• Cryptoization, capital flows, and restrictions • Monetary policy transmission • Bank disintermediation

Source: IMF staff.
Note: AML/CFT = anti–money laundering/combating the financing of terrorism.

have poor operational, cyber risk management, and governance frameworks.[9]

- *Operational risks* can result in significant downtime when failures and disruptions prevent the use of services and even result in large losses of customer funds. Such risks have coincided with periods of high transaction activity and can result from poorly designed systems and controls. For example, on May 19, when liquidations of leveraged positions peaked, major exchanges reported outages, citing "network congestion."
- *Cyber risks* include high-profile cases of hacking-related thefts of customer funds. Such attacks take place on centralized elements of the ecosystem (for example, wallets and exchanges) but can also arise on the consensus algorithms that underpin the operation of blockchains.
- *Governance risks* involve the lack of transparency around issuance and distribution of crypto assets and have resulted in investor losses.

So far, losses as a result of such risks have not had a significant impact on financial stability, globally or domestically. However, as crypto assets grow, the macro-criticality of such risks is likely to increase. In addition, the crypto ecosystem remains exposed to concentration risks, given its large reliance on a few entities (for example, Binance handles more than half of trading volumes, and Tether has issued more than half the supply of stablecoins).

With limited or inadequate disclosure and oversight, the crypto ecosystem is exposed to consumer fraud and market integrity risks. Most crypto assets are highly volatile, speculative assets. One notable recent example was the increased investor interest in "meme tokens" (Figure 2.2, panel 1). Some of these tokens were created for speculation purposes, and their price was highly influenced by social media trends. Relatedly, investors are also likely to face losses from tokens ceasing to exist—something that is less common in regulated securities markets. For example, more than 16,000 tokens have been listed on various exchanges over time, but around 9,000 exist today.[10] Risks can be further amplified by the use of leverage offered in crypto exchanges, which has been as high as 125 times the initial investment. In response to such risks, many jurisdictions have taken action or issued public warnings over the past few months, such as the central banks of Argentina (BCRA 2021), Mexico (Banxico 2021), and Thailand (Thai SEC 2021), which prohibited exchanges from offering tokens with certain characteristics; others imposed regulatory limits or banned derivative products across several exchanges (for example, Japan FSA 2021; UK FCA 2020).

DeFi products can expose users to even larger risks. Products can be more complex and less transparent,

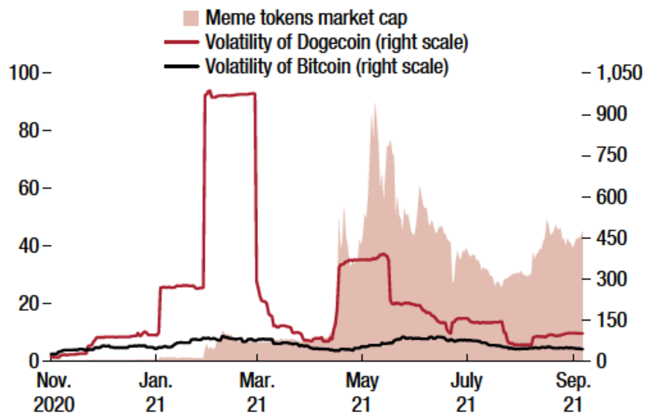
[9]Some notable examples include hacking thefts in Japan (Coincheck in 2018) and Singapore (KuCoin in 2019); the temporary closure of the Philippines Digital Asset Exchange in 2021, reportedly due to large unfunded transactions; the outright collapse of exchanges in Turkey in 2021 (Thodex, Vebitcoin), with claims of billions in stolen assets; and the sudden price collapse and rapid outflows amid flawed collateral management at Bitmex in 2020.

[10]This statistic is based on the number of tokens listed on www.CoinGecko.com.

Figure 2.2. Crypto Ecosystem Challenges

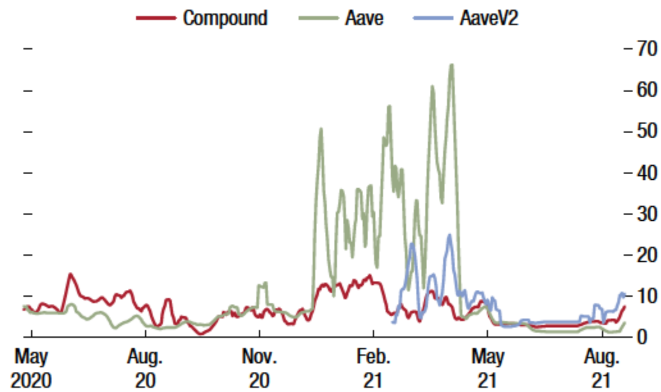
Highly speculative investments, such as meme tokens, experienced large volatility in 2021, even when compared with Bitcoin.

1. Market Capitalization and Realized Volatility
(Billions of US dollars and percent)



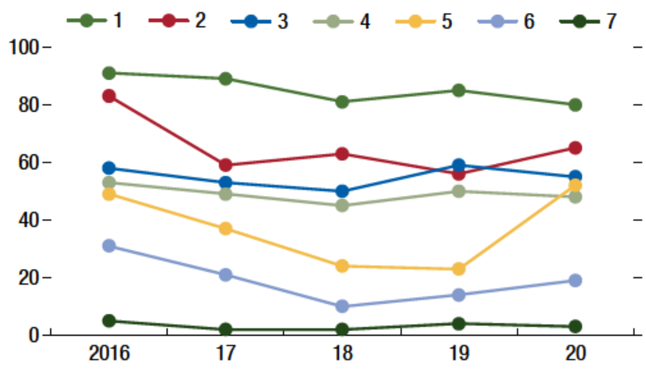
Decentralized finance platforms have been offering attractive but volatile interest rates to users.

2. Borrowing Rates of USD Coin Stablecoin
(Percent)



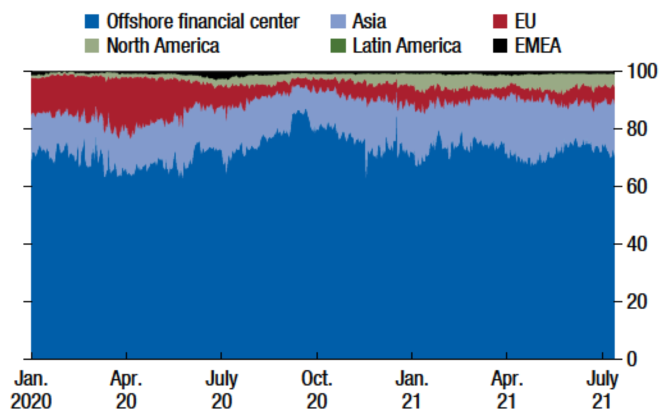
Data gaps can be significant when estimating on-chain activity.

3. Estimated Share of P2P Bitcoin Transactions, Based on Various Data Providers
(Percent share)



Crypto exchange trading activity occurs primarily through entities in offshore financial centers.

4. Trading Activity of Exchanges, by Registration
(Percent share)



Sources: CoinGecko; CryptoCompare; Debank; Financial Action Task Force; and IMF staff calculations.
Note: Panel 1 market capitalization is based on 10 meme tokens from CoinGecko. Panel 3 data come from the Financial Action Task Force (2021) report; the series represent different data providers. The offshore financial center definitions follow IMF (2000). EMEA = Europe, Middle East, and Africa; EU = European Union; P2P = peer to peer; USD = US dollar.

with large technological and governance risks arising from faulty computer code. The lack of central intermediaries complicates authorities' efforts to monitor and regulate these products. As a result, many DeFi products contain risk disclosures that do not adequately warn against their large and volatile returns[11] (Figure 2.2, panel 2). In addition, DeFi has been the victim of hacking, such as the record $0.6 billion hack of Polychain in August, and scams, such as *rug pulls*, in which developers abandon projects but keep investors' funds.

The anonymity of crypto assets and limited global standards create significant data gaps for regulators. Although authorities may be able to trace transactions that are executed on blockchains,[12] they may not be able to identify the parties to a transaction. In addition, the crypto ecosystem falls under varied regulatory

[11]The volatility and lack of disclosure are more prominent in complex products, such as "liquidity mining" (which is offered by decentralized exchanges and compensates users who provide liquidity to automated market makers) and "yield farming" (which aims to optimize returns for liquidity and collateral provision across DeFi services).

[12]One exception is "privacy tokens," which also conceal transaction data (for example, addresses, amounts).

frameworks across countries, which results in little or no monitoring and information sharing across jurisdictions. Despite some progress through the AML/CFT obligations for crypto asset providers set out by the Financial Action Task Force (FATF), their implementation is still at an early stage (FATF 2021), with notable delays in key areas such as the "travel rule."[13]

Monitoring the activity of crypto asset service providers is complicated by limited, fragmented, and, in some cases, unreliable data. Public data sharing by crypto asset providers is currently mostly voluntary and lacking standardization. For example, while most major crypto exchanges report their trading activity, the information content varies widely, ranging from minimal information to full real-time order books. In addition, given that data are self-reported, there are incentives to manipulate the reporting of higher volumes so as to rank higher on exchange rankings.

Analyzing on-chain[14] activity is also challenging, given that data analysis techniques are at an early stage. On-chain data analytics companies have so far focused on detecting illicit activities, as opposed to providing reliable macro-relevant metrics regarding on-chain activity. The FATF recently published a survey (FATF 2021) on the peer-to-peer (P2P) transactions of seven data companies in an attempt to detect the possibility that illicit P2P transfers are growing, given that such transfers are not explicitly subject to FATF standards. The survey shows large variation: one company estimated that 80 percent of the dollar value of Bitcoin transactions in 2020 occurred without a crypto asset provider, while another estimated it at only 3 percent (Figure 2.2, panel 3). The data also show large uncertainty regarding the illicit use of crypto assets, with no clear indication whether activities are moving toward P2P transactions—making it difficult to ascertain the full degree of illicit crypto asset use.

Crypto asset providers offer and market their services in many jurisdictions, which makes their regulation and supervision more challenging. They are often headquartered in jurisdictions with favorable regulatory, tax, and legal frameworks. For example, most transactions on crypto exchanges take place through entities that operate primarily in offshore financial centers (Figure 2.2, panel 4). In addition, many countries do not have conduct or prudential regulations in place that encompass the activities of crypto asset service providers. And even though some jurisdictions require some type of registration or authorization process, the scope of such regulations in many cases is limited to AML/CFT.

The absence of effective supervision and regulatory frameworks can create regulatory arbitrage and curtail enforcement. For example, users can access crypto assets through global crypto exchanges or wallets, even though these providers lack domestic banking relationships. The use of sovereign currencies on these platforms can occur through third-party payment processing companies taking advantage of regulatory loopholes. Some jurisdictions, such as Malaysia, Nigeria, and Turkey, recently imposed restrictions on payments and/or transactions through global exchanges, such as Binance. However, such actions cannot prevent on-chain transactions—for example, P2P transfers through online chat rooms or the use of decentralized exchanges (see the "Cryptoization" section).

Issues Specific to Stablecoins

The term "stablecoin" captures a very diverse set of crypto assets and can be misleading.[15] While all aim to anchor their value to a specific asset (typically the US dollar) or a group of assets, stablecoins can be classified across a spectrum, depending on the type and credit quality of their collateral backing as well as their price stabilization mechanisms (see Figure 2.3, panel 1, for the collateral composition of the four largest stablecoins):

- *Cash-based:* Fully backed by cash or liquid and safe assets (such as bank deposits and US government bills). These stablecoins are redeemable by the issuer at face value. Their reserves are normally maintained by regulated entities, such as onshore US banks, and they may also provide a higher level of transparency, such as detailed disclosure of reserve assets and clear documentation of redemption rights, including full segregation from other corporate assets.

[13]Under the "travel rule," crypto asset providers must obtain, hold, and exchange information about the originators and beneficiaries of crypto asset transfers.

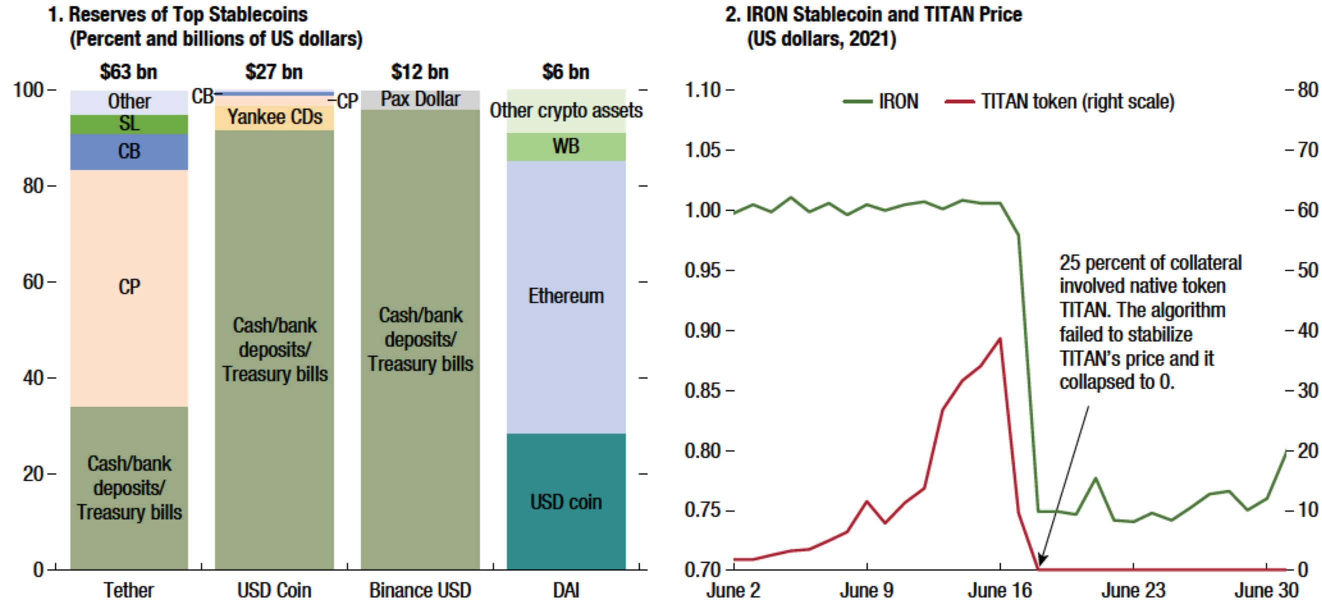
[14]On-chain transactions are recorded and verified on a blockchain. Off-chain transactions take place on a specific platform (for example, a crypto exchange) and not on the blockchain.

[15]For example, the latest consultation of the Basel Committee on Banking Supervision (2021) proposes that the capital requirements for stablecoin exposures be based on a set of conditions that include (1) the regulatory and supervisory status of the entities performing key functions and (2) the effectiveness of the price stabilization mechanism. The so-called stablecoins backed by other crypto assets and algorithms are not deemed to meet the stabilization condition.

Figure 2.3. Stablecoins

Stablecoins vary considerably with respect to their reserve composition.

An algorithmic stablecoin experienced a "bank run" in June as part of its collateral collapsed in value.



Sources: CoinGecko; and company websites.
Note: Panel 1 reserves data are as of June 2021 for Tether, August 2021 for USD Coin, July 2021 for Binance USD, and August 2021 for DAI. At the time, DAI collateralization was more than 200 percent, while the other stablecoins had assets whose value was at least equal to their outstanding issuance. USD Coin consolidates cash and cash equivalents in its disclosure (accounting for about 60 percent of reserves), with cash equivalents defined as securities with an original maturity less than or equal to 90 days, in line with US generally accepted accounting principles. Circle announced that, as of September 2021, 100 percent of USD Coin reserves would be moved to cash and cash equivalents. Binance USD is issued in collaboration with Paxos, with 4 percent of its reserves in Pax Dollar (USDP), a separate native stablecoin of Paxos with under $1 billion in outstanding supply, itself secured by Treasury securities and Federal Deposit Insurance Corporation–insured bank deposits. bn = billion; CB = corporate bonds; CDs = certificate of deposits; CP = commercial paper; SL = secured loans; USD = US dollar; WB = wrapped bitcoin.

- *Asset-based:* Fully backed by noncash equivalent assets (for example, corporate bonds, commercial paper, or commodities) and cash. These stablecoins are akin to money market funds prior to the reforms that followed the global financial crisis. Issuers and exchanges may market these stablecoins as immediately redeemable at face value, but in some cases—especially during periods of market stress—some issuers may be able to defer redemption, offer in-kind redemption, or impose higher redemption fees.
- *Crypto-asset-based:* Backed by other crypto assets. For example, DAI is (over-) collateralized by a portfolio of crypto assets, such as Ether, Bitcoin, and USD Coin. These stablecoins are usually structured on a decentralized, noncustodial basis and are considered part of DeFi. A further category comprises "algorithmic" stablecoins (also referred to as "noncollateralized") that aim to maintain their peg using algorithms that increase or decrease the supply of tokens according to market conditions.

The regulation of stablecoins varies substantially across jurisdictions, inviting concerns about regulatory gaps, inconsistent regulatory treatment, and regulatory arbitrage.[16] The following are three categories of regulation:

- *Comprehensively regulated:* Currently, no stablecoin arrangement fully meets this status.[17] An example of such a stablecoin would be one issued by a commercial bank, subject to comprehensive prudential, conduct, and governance requirements.
- *Partially regulated by existing regimes:* Elements of stablecoin arrangements (for example, for reserve managers) are regulated for conduct and prudential purposes or for limited purposes (for example, AML/CFT).

[16] It is also worth noting that some widely adopted stablecoins can also become a vehicle for money laundering and terrorism financing (FATF 2020).
[17] "Arrangement" refers to all functions behind the stablecoin, including its governance body, reserves manager, exchange selling it to clients, and so on. See FSB (2020) for a full definition.

Some stablecoin issuers, such as trust companies and money transmitters, have been licensed and regulated by the existing regulatory frameworks in the United States. Regulators may be able to access information, but regulatory tools may be limited and unable to address all the risks of stablecoin issuers. Furthermore, some exchanges and wallet providers that support stablecoins may fall only under AML/CFT requirements, while some reserve managers and custodians may be regulated entities.

- *Nonregulated:* No prudential or conduct regulation of stablecoin arrangements. Many regulators are still in the process of developing applicable regulations, as many stablecoins currently fall into this category. Some US dollar stablecoin issuers that have chosen to be headquartered offshore and operate through offshore banks are nonregulated.

Currently, many stablecoins suffer from poor disclosure. Although stablecoin issuers are improving in this regard, there is a need for substantial upgrades to meet the same level of disclosure standards as commercial banks and money market funds. For example, Tether, the world's largest stablecoin by market capitalization, has disclosed the composition of its reserve assets. However, such disclosure is not yet audited by independent accountants, and some important information is still missing, including domicile, denomination of currencies, and sector of commercial paper holdings.

Moreover, the recent disclosure by Tether reveals a higher degree of liquidity mismatch than for other major stablecoins. Even though Tether allows direct and "immediate" 1:1 redemption for US dollars for a small fee, only one-third of its reserves are backed by cash and Treasury bills; about half is invested in commercial paper.

Some stablecoins can be subject to runs, with repercussions for the financial system. This could be driven by doubts about their redeemability at a 1:1 peg due to the value of their reserves or the speed at which reserves can be liquidated to meet potential redemptions. In June 2021 a small algorithmic stablecoin (IRON) experienced a run (Figure 2.3, panel 2) as one-quarter of its reserves were backed by another token (TITAN) whose market value went to zero. Even if stablecoins are, for the time being, not large enough to be deemed "systemic," there are financial stability implications for large banks in the event of fire sales of the assets that back stablecoins. An investor run in one country can also lead to cross-border spillovers if large global crypto exchanges are involved. The concentrated ownership of stablecoins by market makers could also trigger wider contagion.

Run risks could also trigger a fire sale of commercial paper. In many jurisdictions, including the United States, the liquidity of commercial paper is worse than that of other short-term assets, such as government bills, especially during periods of market stress (as seen during the COVID-19 sell-off in 2020). The contagion risk can be much higher where reserve assets are concentrated in particular issuers or sectors. Although this risk might be Tether-specific for now, given its size and types of holdings, this kind of contagion risk could evolve for other stablecoins in the future.

Cryptoization

Crypto adoption in some emerging market and developing economies has outpaced that of advanced economies. According to a recent survey, the top five countries using or owning crypto assets in 2020 were emerging market and developing economies, whereas the lowest adopters were generally advanced economies (Statista 2021).[18] Another recent survey (Finder 2021), with a more limited set of countries, also reaches similar conclusions, placing emerging market economies in Asia among the top and advanced economies, such as the United Kingdom and the United States, among the bottom. Some emerging market country-specific surveys also show a large jump in adoption over the past year.[19]

Beyond surveys, tracking country-specific adoption can be challenging. So far, there is no reliable way to estimate the stock or flow of crypto assets based on country residency. A commonly used proxy is residency estimates based on internet visits to websites of crypto asset providers. These confirm the survey data to show the popularity of several global crypto exchanges among emerging market and developing economies (Figure 2.4, panel 1), but they cannot measure the actual use of crypto assets. Another metric is the size

[18] The Statista survey is based on a relatively limited sample of 1,000–4,000 respondents a country among a group of 74 countries.

[19] The Finder survey is based on 42,000 people across a sample of 27 countries that excludes many emerging markets. Examples include local surveys in Turkey (CoinTelegraph 2021) and Indonesia (Tokenomy 2021), as well as estimates of volumes in crypto exchanges in Brazil (CoinDesk 2021) and Thailand (Bloomberg 2021).

Figure 2.4. Cryptoization Risks

EMDE residents are among the top visitors of major crypto exchange websites.

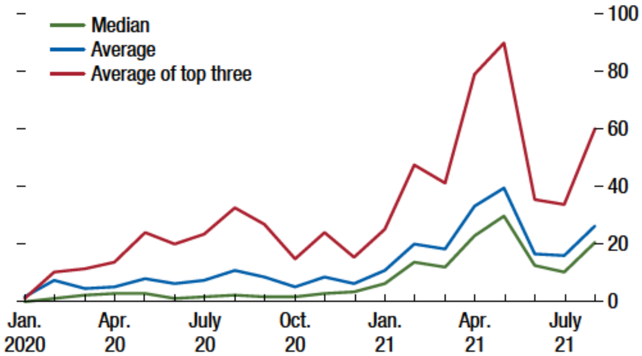
1. Geographic Breakdown of Internet Visitors
(Unique visitors, October 2020–June 2021)

Economies	BINANCE	HUOBI	COINBASE	KRAKEN	FTX	BITHUMB	BITFINEX
Top economy 1	Turkey	China	United States	United States	Turkey	Korea	Russia
Top economy 2	Russia	Ukraine	United Kingdom	Germany	Korea	Russia	Taiwan Province of China
Top economy 3	United Kingdom	Vietnam	Spain	France	China	Turkey	Germany
Top economy 4	Brazil	United States	Germany	United Kingdom	Taiwan Province of China	United States	Ukraine
Top economy 5	Argentina	Russia	France	The Netherlands	Hong Kong SAR	Poland	Brazil

Exchange

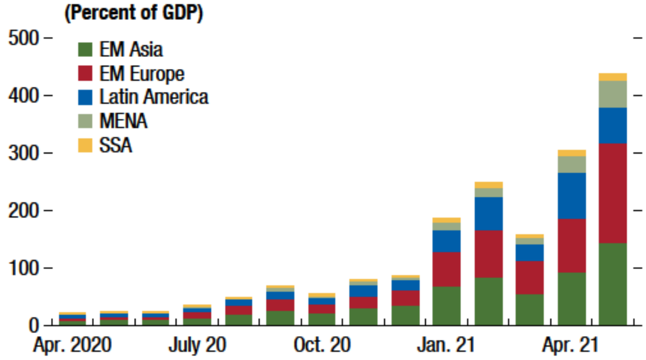
Volumes in local exchanges have grown rapidly and are comparable to some equity markets.

2. Volumes of EMDE Registered Crypto Exchanges
(Percent share of local equity exchange volumes)



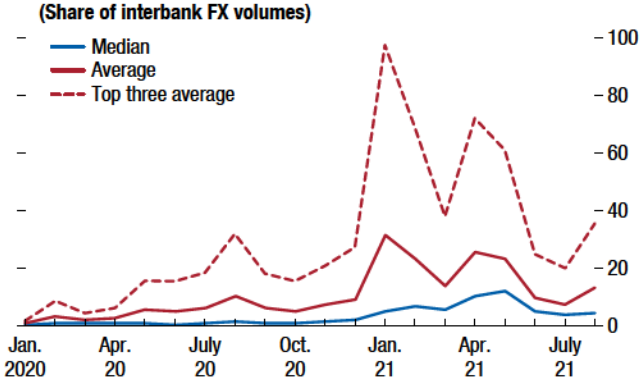
The amount of value received on-chain has grown rapidly by some estimates.

3. Value Received On-Chain among 50 EMDEs
(Percent of GDP)



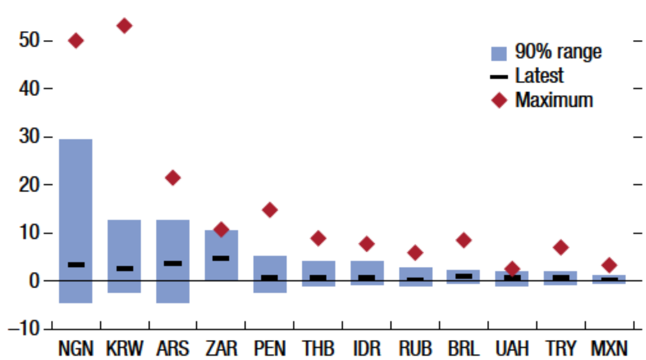
Off-chain trading volumes against some EMDE FX pairs have shown large volatility in 2021.

4. Volumes of EMDE FX on Crypto Exchanges
(Share of interbank FX volumes)



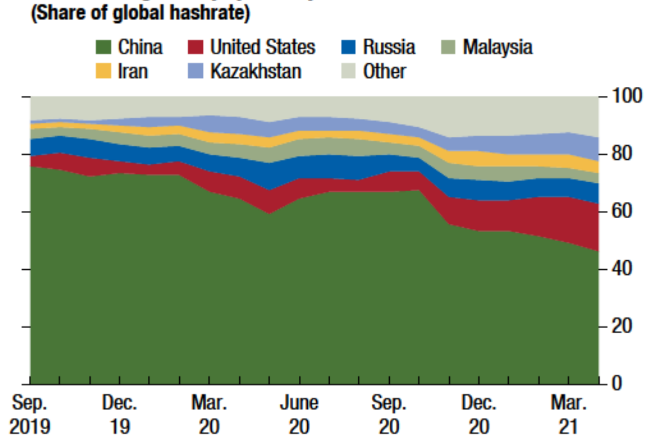
Demand and supply imbalances and capital flow management measures can lead to large market segmentation.

5. Bitcoin Premiums in Local Currency Markets
(Percent deviation since 2018)



The migration of crypto mining can lead to higher electricity usage and on-chain revenues in EMDEs.

6. Bitcoin Mining Activity by Country
(Share of global hashrate)



Sources: Bloomberg Finance L.P.; Cambridge Centre of Alternative Finance; Chainalysis; Cryptocompare; Kaiko; Similarweb; and IMF staff calculations.
Note: Samples for panels 2 and 4 comprise 10 countries. Panel 3 is based on residency estimates from Chainalysis. In panel 5, the Bitcoin premium is calculated as (Bitcoin/LCL × LCL/USD) / (Bitcoin/USD) – 1, in which LCL is the local currency on the *x*-axis. For Nigeria and Argentina, a parallel FX-rate estimate is used. Data labels use International Organization for Standardization (ISO) currency codes. Hashrate measures the computing power used in crypto mining. EMDE = emerging market and developing economy; FX = foreign exchange; MENA = Middle East and North Africa; SSA = sub-Saharan Africa; USD = US dollar.

of trading volumes of crypto exchanges that operate only in specific countries rather than globally. Among a sample of such exchanges in emerging market and developing economies, the reported traded volume in 2021 rose sharply and, in some cases, volumes have become comparable to the activity on the local stock exchange (Figure 2.4, panel 2).[20] Finally, some blockchain analytics companies (for example Chainalysis 2020; Chainalysis 2021a) attempt to infer the residency of on-chain crypto asset flows. Similar to surveys, their data show that adoption in emerging market and developing economies is rising and has outpaced that in advanced economies, but the interpretation of the data poses significant challenges (Figure 2.4, panel 3).[21]

There are several driving forces for cryptoization. Unsound macroeconomic policies combined with inefficient payment systems in some emerging market and developing economies boost crypto adoption. Some potential pull factors for crypto adoption, such as speculative retail investing, may be common across countries (Table 2.2), but some of the recent drivers are likely more specific to a subset of emerging market and developing economies. For example,

- Weak central bank credibility and a vulnerable banking system can trigger asset substitution as domestic residents seek a safer store of value. Dollarization[22] pressures are a persistent risk for several emerging market and developing economies.[23] The crypto ecosystem can help domestic residents convert some of the headwinds of traditional dollarization—such as exchange rate restrictions and challenges in accessing and storing foreign assets—into tailwinds. For example, global crypto exchanges or other less secure methods, such as P2P transfers, can be used to bypass capital flow management measures; private wallets can act as a form of offshore bank account to store wealth.
- Inefficiencies in payment systems and limited access to financial services can also be a driver of dollarization. One prominent example of inefficiencies is the lack of interoperability among various domestic payment systems, which can be a problem for remittances as well as trade.[24] Given the large share of unbanked people in some emerging market and developing economies, remittances often take place through cumbersome cash-based methods, such as those of post offices and other transfer operators. The payment rails of crypto assets can make some of these services faster and cheaper, especially through the integration of stablecoins, which allow for a stable unit of account. Of course, such gains rely on access to the internet and other technologies, which are scarce in many countries.

Table 2.2. Pull and Push Factors Related to Crypto Adoption

Potential Adoption Drivers for Emerging Market Users
Pull Factors
Returns from speculative investment Relative transaction costs and speed Competitive financial products Reduced AML/CFT standards Convenience of "on-chain" custody
Push Factors
Unsound domestic macro policies FX restrictions Vulnerable banking sector Exclusion from other financial services

Source: IMF staff.
Note: AML/CFT = anti–money laundering/combating the financing of terrorism; FX = foreign exchange.

Macro-financial challenges depend critically on the degree of adoption.

- A *limited degree of adoption*—for example, small-scale use of crypto assets for remittances—will pose some of the challenges discussed earlier (see the "Challenges Posed by the Crypto Ecosystem" section) but will have a marginal impact on monetary policy or capital flows. Even when crypto payment rails are used, the underlying crypto assets will likely

[20]The presence of multiple exchanges quoting the same trading pairs could lead to double counting, as a buyer on one exchange can be a seller on another.

[21]For example, large volumes might result from on-chain transfers between wallets of crypto asset providers rather than increased use of crypto assets by retail users. In addition, residency-based estimates usually rely on web traffic data, which can be compromised by the use of technologies that mask online activity, hence reducing their accuracy.

[22]Dollarization here refers to the de facto adoption of a foreign currency (not necessarily the dollar) or asset that displaces the domestic currency, driven by the preferences of the economy's residents. The primary driver of the adoption can be a new means of payment and unit of account (currency substitution) or a safer store of value (asset substitution).

[23]For example, among a sample of 65 emerging market and developing economies that are not de jure dollarized, 2020 data showed that about one-third have foreign currency exceeding 30 percent of both total loans and deposits.

[24]See the discussion in IMF and BIS (2021) for some well-known issues with international remittances. Chainalysis (2020) discusses the increasing use of crypto assets for remittances and trade.

be held for only a short time (for example, the duration of the remittance) before users exchange them for local currency to make purchases domestically.

- *More extensive degrees of adoption* [25]—such as the adoption of stablecoins[26] as means of payment and store of value—can pose more significant challenges by reinforcing dollarization forces in the economy. Dollarization can impede central banks' effective implementation of monetary policy and lead to financial stability risks through currency mismatches on the balance sheets of banks, firms, and households. This can be further amplified by liquidity risks, as central banks are not able to provide liquidity backstops in foreign units of account (IMF 2020a). Cryptoization could moreover pose a threat to fiscal policy: crypto assets can facilitate tax evasion, and seigniorage revenue may also decline due to the shrinking role of central bank money in the economy.

The adoption of a crypto asset as the main national currency carries significant risks and is an inadvisable shortcut. Adrian and Weeks-Brown (2021) discuss such risks to macro-financial stability, financial integrity, consumer protection, and the environment. For now, the probability of such a scenario occurring due to a choice of households and businesses is low for most countries, given that the value of non-stablecoin crypto assets is too volatile and unrelated to the real economy to become the main unit of account. Such a scenario, however, could arise in countries with weak monetary and exchange rate policies where the risks associated with the use of volatile crypto assets is still a relative improvement over existing policies.

Increased demand for crypto assets could facilitate capital outflows that affect the foreign exchange market. Crypto exchanges play the crucial role of facilitating the conversion of local currency to crypto assets and vice versa. The natural[27] demand and supply for conversions can easily become unbalanced over the 24/7 trading period of crypto asset markets. For markets to clear, some market makers must provide liquidity by trading more liquid pairs (such as US dollar–Bitcoin and US dollar–local currency) to determine the price of the less liquid pair (local currency–Bitcoin). This type of triangular arbitrage is usually facilitated by institutional participants that have access to larger pools of liquidity in markets that do not include domestic retail participants (for example, offshore funding markets). In periods when domestic demand for crypto assets rises substantially, these institutional participants can act as gateways for conversion of crypto asset demand to capital outflows through the exchange rate market. The recent sharp rise in trading volumes of crypto assets against some emerging market and developing economy currencies (Figure 2.4, panel 4) may have been the source of spillovers in the exchange rate market that led to recent restrictions imposed by authorities.

Policy measures can be somewhat effective at ring-fencing the impact of rising crypto asset demand in the foreign exchange market. Capital flow management measures and other crypto-asset-specific measures can have a notable impact in terms of creating market segmentation (see Makarov and Schoar 2020). For example, in Korea, Bitcoin purchases had premia as high as 50 percent in 2018 due to strong domestic demand and restrictions that kept arbitrage activities at bay (Figure 2.4, panel 5).[28] However, such restrictions on crypto asset trading may trigger new leakages as trading moves away from exchanges and over to peer-to-peer[29] and other less formal or less visible channels (such as chat rooms on the instant messaging system Telegram).

A migration of "mining" activity to emerging market and developing economies can also have serious implications for capital flows as well as for energy consumption. Validating on-chain transactions for many crypto assets is done by so-called proof-of-work or mining, whereby members of the network solve a complex mathematical problem using computing power. Following a crackdown on mining activity in China in early 2021, mining activity started to migrate to other emerging market and developing economies and to the

[25]A challenge that is not covered in this chapter is the capacity of blockchains to process large amounts of payments in an economy, given their scalability problems; more recently, some newer technologies (such as layer 2 networks) have made it more feasible to solve such problems.

[26]Compared with other volatile crypto assets, stablecoins are likely to be a more desirable store-of-value, given their link to a familiar unit of account (usually the US dollar) and such features as anonymity and access to DeFi.

[27]For example, natural sellers can be recipients of remittances, while buyers can be speculators that want to position for a rally in Bitcoin.

[28]Korea is classified as an advanced economy, but its relatively large crypto ecosystem offers meaningful lessons.

[29]For example, Binance has increased its presence in P2P markets in Africa, and other P2P platforms, such as Paxful, have seen a notable increase in volumes there.

United States (Figure 2.4, panel 6). This movement can have important implications for

- *Energy consumption:* Miners use electricity to power their hardware. By some estimates, mining in the Bitcoin network consumes about 0.36 percent of the world's electricity—comparable[30] to the consumption of Belgium or Chile. Large migration of mining activity can lead to a significant rise in domestic energy use, especially in countries that subsidize energy costs. However, future generations of Ethereum and other smart blockchains are expected to consume much less energy than Bitcoin.
- *Capital flows:* Miners are rewarded for their activities on-chain in the form of crypto assets. For example, the value of mining revenues in 2021 has exceeded $1 billion a month, on average, for each of the Bitcoin and Ethereum blockchains. Mining revenue can potentially be used to circumvent capital flow restrictions as well as international financial sanctions, given that the main operating costs of miners (for example, electricity) are normally paid domestically in local currency, but their revenues are paid on-chain in the form of crypto assets.

The banking sector can also come under pressure if the crypto ecosystem becomes an alternative to domestic bank deposits or even loans. Stronger competition for bank deposits through stablecoins held on crypto exchanges or private wallets may push local banks toward less stable and more expensive funding sources to maintain similar levels of loan growth. Beyond the direct loss in net interest income, a loss of customer relationships and data on transactions would also undermine credit risk assessment for clients and their ability to offer targeted products to clients.

Policies to Ensure Macro-Financial Stability

Fintech innovation, including the crypto ecosystem, has the potential to improve fundamental aspects of the macroeconomy with better financial services and greater financial inclusion, especially in emerging market and developing economies. Policymakers need to balance enabling financial innovation and reinforcing competition and the commitment to open, free, and contestable markets, on one hand, against challenges to financial integrity, consumer protection, and financial stability. As a first step, regulators and supervisors need to be able to monitor rapid developments and the risks they create. Depending on country circumstances, various forms of crypto assets may be adopted, and their economic functions may vary. Different countries have different policy priorities arising from the degree of crypto adoption and their existing vulnerabilities. For example, the risks connected with adoption for transaction purposes differ from those arising from widespread use as a store of value or a new unit of account. Risks to financial integrity are high from crypto assets operating on anonymous platforms, but they may be addressable for some stablecoins.

This chapter offers policy recommendations relating to three main areas: (1) regulation, supervision, and monitoring of the crypto ecosystem; (2) stablecoin-specific risks; and (3) managing the macro-financial risks in emerging market and developing economies. Table 2.3 summarizes the policy advice that builds on findings presented in this chapter and other IMF work (IMF 2019; IMF 2020a; IMF 2021).

Table 2.3. Main Policy Recommendations

Standards, Supervision, and Data	• National regulators should prioritize the implementation of global standards applicable to crypto assets • Regulators need to control the risks of crypto assets, especially in areas of systemic importance • Coordination among national regulators is key for effective enforcement and less regulatory arbitrage • Regulators should address data gaps and monitor the crypto ecosystem for better policy decisions
Stablecoins	• Regulations should be proportionate to the risk and in line with those of global stablecoins • Coordination is needed to implement recommendations in areas of acute risk; enhanced disclosure, independent audit of reserves, fit and proper rules for network administrators and issuers; and more
Managing Macro-financial Risks	• Enact de-dollarization policies, including enhancing monetary policy credibility; a sound fiscal position; effective legal and regulatory measures; and the implementation of central bank digital currencies • Capital flow restrictions need to be reconsidered with respect to their effectiveness, supervision, and enforcement

Source: IMF staff compilation.

[30]For a discussion of the merits of these types of comparisons of energy usage, see https://cbeci.org/cbeci/comparisons.

Standards, Supervision, and Data

National regulators should prioritize the implementation of complete global standards applicable to crypto assets. Although standards applicable to crypto assets are currently limited to AML/CFT (FATF) and proposals on the exposure of banks to crypto assets (BCBS), other standards—such as those of the International Organization of Securities Commissions (IOSCO) and the Committee on Payments and Market Infrastructures' Principles for Financial Market Infrastructures (CPMI/PFMI)—provide a robust groundwork for regulation and supervision of crypto assets.[31] For example, standards regarding the powers and independence of supervisors, operational resilience, disclosure, and governance have existed for some time, but still lack adequate implementation. If crypto exchanges deal with tokens that meet the definition of securities, those entities should be subject to existing international standards for securities intermediaries. All jurisdictions should implement such standards. Globally, policymakers should prioritize making cross-border payments faster, cheaper, more transparent and inclusive through the G20 Cross Border Payments Roadmap (G20 2020). The IMF can support such efforts through Financial Sector Assessment Programs and technical assistance.

Robust and globally consistent standards are needed to mitigate financial stability risks. Where standards have not yet been developed, regulators need to use existing tools to control risk and implement a flexible framework for crypto assets. The growing systemic implications of crypto assets may indeed warrant immediate regulatory action in some countries. Regulators must use existing measures and international standards by focusing on areas of acute risk, such as wallets, exchanges, and financial institutions' exposures. Authorities should ensure that the regulatory framework is flexible enough to be adjusted in the future, in line with forthcoming international standards. Interim measures should be taken, including clear consumer warnings and investor education programs, especially where crypto adoption has been fast, such as in some emerging market and developing economies.

National regulators should enhance cross-border coordination of supervision and enforcement actions. For example, because it is difficult to implement and enforce an adequate regulatory framework, some authorities have taken strong actions, such as banning unregulated crypto asset activities. Although bans can have a direct impact on the business of crypto exchanges, individuals are still likely to be able to trade and exchange crypto assets by alternative means. Therefore, jurisdictions should actively coordinate with the relevant authorities and international standard-setting bodies to maximize the effectiveness of their enforcement actions and minimize regulatory arbitrage. Greater cross-border collaboration can enhance enforcement actions, but the resources needed for such enforcement may present a greater challenge for emerging market and developing economies.

Swiftly tackling data gaps is central to inform policy decisions. Greater data standardization can lead to better oversight of new developments and a more accurate understanding of risks and can support proportionate regulation of crypto asset markets. In that regard, an international agreement on common minimum principles for data should be developed. A globally consistent taxonomy can help data standardization and cooperation. There is also scope for international coordination on compilation and sharing of data sources from private companies for regulatory and public policy purposes.

Stablecoins

Stablecoins require regulations proportionate to their risk and the economic functions they serve, taking into account recommendations put forward by the Financial Stability Board, which recently finalized 10 high-level recommendations comprehensively covering requirements—such as governance, risk management, transparency, and redemption rights—with the underlying principle of "same business, same risk, same rules." As a matter of priority, authorities should ensure that widely used stablecoins have effective risk management frameworks with regard to credit and liquidity risks as well as operational, AML/CFT, and cyber risks, among others. Regulation and supervision of stablecoins could be enhanced through cooperation agreements between country authorities that consider the various types of risks stablecoins pose for each country. Certain US dollar–linked stablecoins seek to base their operations in chartered banks in the United States. Meeting banking license requirements would resolve many regulatory challenges.

[31]The IMF has previously highlighted the relevance of existing underlying principles of financial regulation that are applicable to crypto assets (see Cuervo, Morozova, and Sugimoto 2020).

There are areas of acute risk in stablecoin arrangements that require more immediate attention. Various functions, including reserves management, network administration and governance, custody, and exchange services, can generate risks to consumer protection, financial stability, market and financial integrity, and operational and cyber resilience. Authorities should consider measures—such as enhanced disclosure requirements, independent audit of reserves, fit and proper rules for network administrators and issuers, and rules around enhanced operational and cyber resilience—to reflect the increased reliance on digital platforms and various types of distributed ledger technology. Where stablecoins generate systemic risk, their regulatory obligations should reflect this position, with rules aligned with traditional entities that provide similar products (for example, bank deposits, digital payments, money market funds, and so on).

Managing Macro-Financial Risks

Reversing or averting dollarization requires strong macroeconomic policies, but these may not by themselves be enough. Crypto assets on their own do not change the economic forces that lead to the international use of currencies or increased dollarization. Yet the technological advance of the crypto ecosystem, and especially stablecoins, could reinforce the incentives behind currency and asset substitution and ease adoption. Hence, the tolerance for policy missteps is greatly reduced (IMF 2020a). Countries that want to fend off dollarization will need to strengthen monetary policy credibility, safeguard the independence of central banks, and maintain a sound fiscal position along with effective legal and regulatory measures to disincentivize foreign currency use. Similarly, although simply issuing central bank digital currencies does not automatically change the incentives to hold foreign currencies, central bank digital currencies may help reduce dollarization if they help satisfy a need for better payment technologies. A number of countries have launched similar projects to modernize their payment systems, taking advantage of the latest developments in digital technology and using the domestic currency for instant payments.

The design of capital flow restrictions in a digital world needs to be reconsidered, including via stablecoin regulations. Applying established regulatory tools to manage capital flows may be more challenging when value is transmitted on new platforms that are not bound by existing capital flow management measures (IMF 2021). Because of the way private entities organize or relocate their activities, the effectiveness of regulation, supervision, oversight, and enforcement of capital flow management measures faces challenges at jurisdictional levels. Therefore, there is a need for cross-border collaboration and cooperation to address the technological, legal, regulatory, and supervisory challenges (IMF 2021; IMF and BIS 2021). In particular, the host authorities where stablecoins are more widely used should be encouraged to establish a close coordination mechanism with the home regulator where stablecoin reserves are managed.

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